

Prepared by JMA
Agenda Item: 4
Discussed in Plenary

JMA REPORT ON THE STATUS OF CURRENT AND FUTURE SATELLITE SYSTEMS

In response to CGMS recommendation:

Plenary/J.2 R46.12

CMA, JMA, KMA to jointly build a portal in the Project website for their operational information regarding rapid-scanning observations on demand from geostationary meteorological satellites in the regions.

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI). Himawari-8 has been stably operational since July 2015, and the operation is planned to be taken over by Himawari-9 in 2022.

In January 2018, JMA launched a new international service HimawariRequest, in collaboration with Bureau of Meteorology in Australia. The service allows NMHS users in Himawari-8/9 coverage area to request AHI's Target Area observation covering a 1,000 km x 1,000 km area every 2.5 minutes. JMA had taken registrations from eighteen NMHSs in WMO RA II and RA V so far, and there has been 18 international requests to monitor tropical cyclones, bush fires, volcanic eruptions and so on. In response to CGMS recommendation R46.12, CMA, JMA and KMA launched a portal resource on the RA II WIGOS Project website for user convenience at https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html#request. JMA provides information on past, current and planned observation schedules for target-area observation, including that conducted under the HimawariRequest service.

In JFY 2018, JMA has started considering the next geostationary satellite program. JMA will pursue a seamless geostationary satellite system, keeping in mind the CGMS baseline and Vision for WIGOS in 2040.

Action/Recommendation proposed: none

JMA report on the status of current and future satellite systems

1 INTRODUCTION

This paper reports on the status of JMA's current and future satellite systems.

2 CURRENT SATELLITE SYSTEMS

Table 2.1 JMA's current GEO satellites

Sector	Satellite	Location	Launch date DD/MM/YYYY	Data Access	Payload and status
East Asia and Western Pacific	Himawari-8	140.7°E	07/10/2014	HimawariCast HimawariCloud	16-channel AHI, DCS, SEDA; operational
	Himawari-9	140.7°E	02/11/2016	HimawariCast HimawariCloud	16-channel AHI, DCS, SEDA; in-orbit standby

2.1 Status of current GEO satellite systems

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI) units. JMA has established a satellite observation system with redundancy based on twin satellite operation, which is expected to contribute to disaster risk reduction in Asia and the western Pacific until 2029. Himawari-8 will chiefly be used for observation during the early part of this period, with Himawari-9 in a back-up role. Their operation will be switched in 2022 to place Himawari-9 in the main observation role with Himawari-8 as back-up.

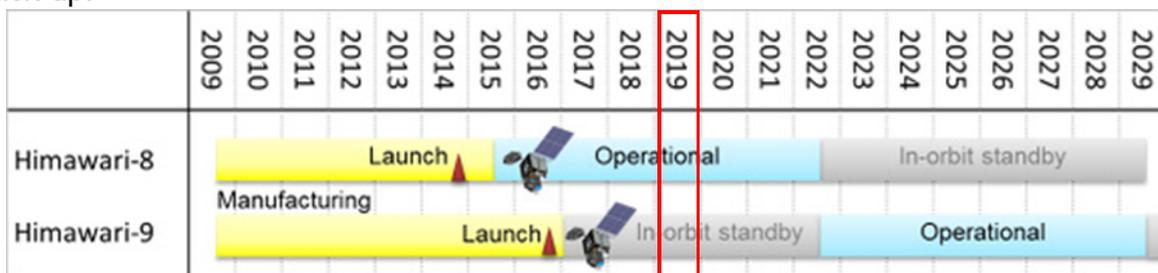


Figure 1: Himawari-8/-9 timeline

2.1.1 Status of spacecraft

2.1.1.1 Himawari-8

The status of Himawari-8 is normal, with no significant anomalies since CGMS-46. The following webpage provides information on irregular events, processing events and data outages of the satellite:

Himawari-8 Event Log, MSC/JMA

https://www.data.jma.go.jp/mscweb/en/operation8/event_H8.html

Himawari-8 maintenance was performed from 15:00 to 16:50 UTC on 19th February 2019. The satellite performed no observation during this time.

2.1.1.2 Himawari-9

The status of Himawari-9 is normal, with no significant anomalies since CGMS-46. The following webpage provides information of irregular events, processing events and data outages of the satellite:

Himawari-9 Event Log, MSC/JMA

https://www.data.jma.go.jp/mscweb/en/operation8/event_H9.html

In the event of a critical Himawari-8 malfunction, Himawari-9 will begin back-up observation.

JMA performed two health check (HC) operations to verify Himawari-9's status in 2018. Table 2.2 lists the HCs conducted since the commencement of the satellite's period of back-up operation.

Table 2.2 Himawari-9 health check operations

Term	Observation as operational satellite
29 May – 12 Jun. 2017	---
29 Aug. – 13 Sep. 2017	---
28 Nov. – 12 Dec. 2017	---
31 Jan. – 16 Feb. 2018	13 – 15 Feb. 2018
2 Oct. – 19 Oct. 2018	---



2.1.2 Impact on spacecraft due to space weather

Space weather related spacecraft anomalies (Items in bold are required)

Table 2.3 Source: Recommendations for Contents of Anomaly Database for Correlation with Space Weather Phenomena, P. O'Brien, J.E. Mazur, T. Guild, November 2011, AEROSPACE Report No. TOR-2011(3903)-5.

1. Date and Universal Time of the anomaly	2. Fully specified location of the anomaly (spacecraft location)	3. Velocity or orbital elements at time of the anomaly	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in spacecraft coordinates	6. Velocity vector of spacecraft in spacecraft coordinates	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)

Taxonomy of Satellite Anomalies Caused by In Situ Charged Particle Environment (to be used for column 7):

- 1. Electrostatic discharge (charging)
 - 1.1 Surface charging
 - 1.1.1 Plasma sheet (subauroral)
 - 1.1.2 Auroral
 - 1.2 Internal charging
 - 1.2.1 Subsurface charging (e.g., beneath blanket)
 - 1.2.2 Deep charging (e.g., inside a box)
- 2. Single-Event Effects
 - 2.1 Protons
 - 2.1.1 Solar proton event
 - 2.1.2 Geomagnetically trapped protons
- 2.2 Heavy ions
 - 2.2.1 Galactic Cosmic Rays
 - 2.2.2 Solar energetic particles
 - 2.2.3 Geomagnetically trapped heavy ions
- 3. Total Dose
 - 3.1 Long-term dose accumulation (multiple causes combined)
 - 3.2 Short-term (days or less) dose accumulation
 - 3.2.1 Solar protons
 - 3.2.2 Geomagnetically trapped protons
 - 3.2.3 Geomagnetically trapped electrons

2.1.3 Ground segment matters

The availability of the Himawari-8 and -9 ground systems was normal during the reporting period.

2.1.4 Data transmission

JMA mainly distributes Himawari-8/9 data in two ways. One is the HimawariCast service, by which primary sets of imagery are disseminated as operational meteorological services via a commercial communication satellite. The other is the HimawariCloud service, by which full sets of imagery are delivered to National Meteorological and Hydrological Services (NMHSs) via a private Internet cloud service. JMA also distributes Himawari-8/9 data to NMHSs via JDDS (the JMA Data Dissemination System) and, in conjunction with four other Japanese institutions, provides Himawari-8/9 data distribution/archive services for research, development and education purposes.

2.1.4.1 HimawariCast service

JMA started the HimawariCast service on 29 January 2015. Himawari imagery in full-disk HRIT/LRIT files is compatible with previous MTSAT HRIT/LRIT data. Files are provided every 10 minutes, and the number of bands for HRIT files is 14 out of Himawari-8/9's 16. These multi-band high-frequency observation data support the timely creation of RGB products and are expected to contribute to disaster risk reduction in the East Asia and Western Pacific regions.

JMA also disseminates meteorological data and products in Satellite Animation and Interactive Diagnosis (SATAID) format, including numerical weather prediction products and observational data. The Agency's SATAID software enables the superimposition of these data and products onto satellite imagery.

Up-to-date information, including specifications of equipment needed to receive data via HimawariCast, is available at:

https://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html

2.1.4.2 HimawariCloud service

JMA launched the HimawariCloud service on 8 April 2015 with the distribution of Himawari-8 in-orbit-test imagery.

Himawari Standard Data are used as master data from all 16 bands with the finest spatial resolution to create all products related to Himawari-8/9. True-color images composed of data from three visible bands are provided in Portable Network Graphics (PNG) format. In addition, images of Target Areas observation in Network Common Data Form (NetCDF) are also created and distributed.

NMHSs in the Himawari-8/9 coverage area can access HimawariCloud and retrieve data using an HTTP 1.1 client such as a Web browser or Wget. A minimum of 20 Mbps throughput between HimawariCloud and the user client is needed to download all data provided via the HimawariCloud service. It should be noted that HimawariCloud is not a data archive service. Data can be downloaded for 72 hours after receipt by the HimawariCloud server, and are then deleted.

The following web page provides technical information on how to access/download data and other matters via HimawariCloud:

https://www.data.jma.go.jp/mscweb/en/himawari89/cloud_service/cloud_service.html

2.1.4.3 JMA Data Dissemination System (JDDS)

JMA provides an FTP service via JDDS for the dissemination of a variety of meteorological data to NMHSs. Satellite imagery and High-resolution Cloud Analysis Information (HCAI) derived from satellite observation are also provided via the service. Satellite imagery via JDDS intends to support users of former operational MTSAT series as an interim measure until users become ready to receive Himawari-8/9 imagery via HimawariCloud or HimawariCast.

A new JDDS service provided via HTTPS will start in June 2019, and the FTP-based JDDS service will be terminated in March 2020.

The following web page provides the information of distribution via JDDS:

https://www.data.jma.go.jp/mscweb/en/himawari89/JDDS_service/JDDS_service.html

2.1.4.4 Distribution service for research, development and education

The following four Japanese institutions operate Himawari-8 data archiving and redistribution services on a best-effort basis for research, development and education:

- NICT Science Cloud <http://sc-web.nict.go.jp/himawari/> (Japanese)
- CEReS <http://www.cr.chiba-u.jp/english/>
- EDITORIA-DIAS <http://www.diasjp.net/en/>
- JAXA-EORC <http://www.eorc.jaxa.jp/ptree/index.html>

Users must register to download data from each institution and observe the individual data usage policies.

2.1.5 Projects, services

2.1.5.1 Data Collection System

Himawari-8 currently supports the Data Collection Service. Monthly reports on Himawari-8's IDCS is available at Monthly Operation Report, MSC/JMA https://www.data.jma.go.jp/mscweb/en/operation8/opr_report.html.

See the CGMS-47-JMA-WP-02 for more information on Himawari-DCS.

2.1.5.2 Space Environment Data Acquisition

Himawari-8 and -9 have instruments to sense proton and electron flux for satellite housekeeping known as SEDA (Space Environment Data Acquisition). SEDA text data acquired from the satellites are provided to the National Institute of Information and Communications Technology (NICT) to support near-real-time space environment monitoring and forecasting. For more information, see the NICT Space Weather Information Center Web page at

HIMAWARI/SEDA DATABASE, NICT
<http://seg-web.nict.go.jp/himawari-seda/>.

2.1.5.3 HimawariRequest Service

In January 2018, JMA launched a new international service "HimawariRequest", in collaboration with the Australian Bureau of Meteorology. The service allows NMHS users in Himawari-8/9 coverage area to request Target Area observation covering a 1,000 km x 1,000 km area every 2.5 minutes.

As of 9 April 2019, JMA had taken registrations from eighteen NMHSs in RA II and RA V, and opened the service to the fifteen whose preparations for request submission were complete. There have been 18 international requests since the commencement of the service, among which 11 have been accepted as listed in Table 2.4.

Table 2.4 HimawariRequest

#	Date	Requester	Event Type
1	15/10/2018 - 17/10/2018	Australia	Sever weather
2	30/11/2018 - 03/12/2018	Australia	Bush fires
3	03/12/2018 - 05/12/2018	Australia	Tropical Cyclone
4	10/12/2018 - 17/12/2018	Australia	Tropical Cyclone
5	29/12/2018 - 31/12/2018 04/01/2019 - 23/01/2019	Indonesia	Volcanic Eruption
6	23/01/2019 - 25/01/2019	Australia	Tropical Cyclone
7	25/01/2019 - 27/01/2019	Australia	Forest fires
8	18/02/2019 - 19/02/2019	Australia	Tropical Cyclone
9	01/03/2019 - 05/03/2019	Australia	Forest fires
10	13/03/2019 - 26/03/2019	Australia	Tropical Cyclone
11	04/04/2019 - 09/04/2019	Australia	Tropical Cyclone

In September 2018, JMA began implementing another regional observation covering 1,000 x 1,000 km every 2.5 minutes by concatenating Landmark Area (Region 4)

observations over an area of 1,000 x 500 km every 30 seconds. This observation is exclusively for Volcanic Ash Advisory Center (VAAC) Tokyo operation, and results in increased capacity for target-area observation under the HimawariRequest service.

In response to CGMS recommendation R46.12, CMA, JMA and KMA launched a portal resource on the RA II WIGOS Project website for user convenience at:

Request-based high frequency regional observation, RA II WIGOS Project
https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html#request.

The resource provides operational information regarding on-demand rapid-scanning observation from geostationary meteorological satellites in the Asia-Oceania region.

JMA provides information on past, current and planned observation schedules for target-area observation, including that conducted under the HimawariRequest service, at:

- Past:
https://www.data.jma.go.jp/mscweb/data/himawari/obs_info_tg_en.html,
- Current:
https://www.data.jma.go.jp/mscweb/data/himawari/sat_tga.php,
- Planned:
<https://www.jma-net.go.jp/sat/data/Request/RequestStatus.html>.

2.1.5.4 JMA and JAXA Collaboration

JMA has established Regional Specialized Meteorological Center (RSMC) Tokyo for Nowcasting in 2018, which supplies national meteorological services with graphical nowcasting products to help improve capacity for disaster risk reduction in Asia-Pacific regions. Japan Aerospace Exploration Agency (JAXA) has also provided global precipitation map called GSMaP (Global Satellite Mapping of Precipitation) generated by multi-satellite sensors, which has been used for operational purposes such as rainfall monitoring at some NMHSs in Asia-Pacific regions. Recently JMA and JAXA have started the close collaboration on the development of regional integrated precipitation product by using ground/space observation.

3 HIMAWARI-8/9 FOLLOW-ON PROGRAM

In FY 2018, JMA has started considering the Himawari-8/9 follow-on program. JMA will pursue a seamless geostationary Earth orbit satellite system, keeping in mind the CGMS baseline and the Vision for WIGOS in 2040.

The Implementation Plan of the Basic Plan on Space Policy, which is decided/revised by the Strategic Headquarters for National Space Policy, Cabinet Office, Government of Japan, states that “By FY2023 Japan will start manufacturing the Geostationary Meteorological Satellites that will be the successors to Himawari-8 and -9, aiming to put them into operation in around FY2029”.

4. (2) ①ii) Satellite remote sensing

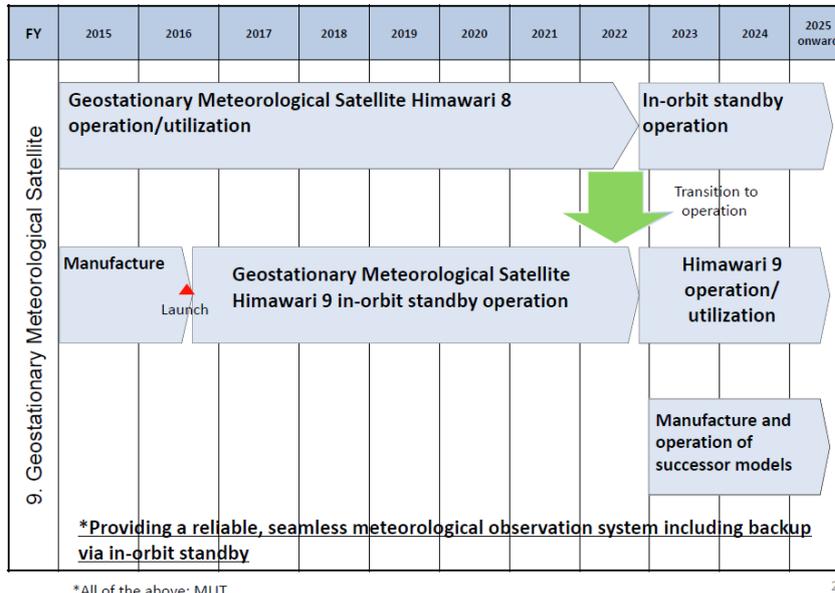


Figure 3 Description of Japan’s geostationary meteorological satellites in the Implementation Plan of the Basic Plan on Space Policy revised in FY2017 (Full Text (Tentative Translation): <http://www8.cao.go.jp/space/english/basicplan/2017/basicplan.pdf>)

4 CONCLUSIONS

Himawari-8 and -9 are operating normally with no significant anomalies, and JMA now operates the related HimawariRequest service to help mitigate disaster conditions in the Asia-Pacific region. The Agency is also considering the follow-on satellites that will take over from Himawari-8 and -9. JMA and other CGMS members are expected to benefit from information on anticipated impacts brought by new instruments such as the hyperspectral IR sounder and lightning mapper.